

AN APPLICATION FOR
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Description

PRESENCE REGISTRATION AND ROUTING NODE

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Related Application Information

This application claims the benefit of United States Provisional Patent Application Number 60/191,278, filed March 22, 2000, the disclosure of which is incorporated herein by reference in its entirety.

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Technical Field

The present invention relates to presence database services, and more particularly to the routing and processing of presence service related signaling messages in a communications network.

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Background Art

Instant messaging (IM), as it is currently known within the communications industry, is an Internet technology that allows subscribers to send and receive text messages, voice messages and other data in near real-time. While IM started as a way to chat with friends, the technology has become an essential tool for many businesses, as it offers the convenience of e-mail and the immediacy of a phone call, as well as file transfers and voice messaging.

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Instant messaging is possible because the people sending and receiving messages remain constantly connected to their IM service.

Recipients get messages as fast as the data can travel across the Internet. Conventional e-mail, on the other hand, is less immediate. E-mail technology sends messages to a server that stores the items until they are downloaded by the recipient's e-mail software. Many industry experts argue that it is the

5 "instant" or near real-time communication characteristic that has made and will continue to make IM a mode of communication in the future.

At present, when a subscriber logs in to an IM service, the subscriber's software notifies a presence server or similar client based presence system that the subscriber is available to receive messages. Such a scenario is

10 generally illustrated in Figure 1. Once the subscriber is logged in or "registered," the subscriber can choose to send a message to another online user. From a network communication perspective, such a communication is accomplished via the sending of data packets containing address and user-type information to the intended recipient. Depending on which service is

15 used, a server either directly relays the message to the recipient or facilitates a direct connection between the sender of a message and the recipient. In Figure 1, communication between IM clients **100** is facilitated by presence server **102**. In order to communicate with other instant message clients, subscribers send registration messages to presence server **102**. The

20 registration messages may contain contact information for IM clients **102**. A proposed presence protocol for performing registration and subscription services will be discussed in more detail below.

IM services typically employ one of three means to move messages around: a centralized network, a peer-to-peer connection, or a combination of

25 both. In a centralized setup, users are connected to each other through a

series of data servers. Such servers effectively form a wide area network (WAN). Consequently, when an instant message is sent by a subscriber, at least one of the data servers finds the intended recipient's PC address and routes the message through the network until it reaches its destination.

In the peer-to-peer approach, a central server maintains a database of online subscribers and their associated Internet Protocol addresses. After a subscriber logs in, such a server sends the subscriber the IP addresses of everyone on their contact list who is also currently logged on.

When a subscriber wishes to send an instant message to another user, the subscriber's client sends the IM directly to the user's client, without involving the server. As such, all IM message traffic does not necessarily go through the entire network. Such an architecture tends to result in improved network performance, as compared to other IM schemes.

An excellent discussion of a proposed presence protocol can be found in "The Presence Protocol," internet-draft-saraswat-presenceprotocol-00.txt, February 26, 1999, the disclosure of which is incorporated herein by reference in its entirety. In the proposed presence protocol specification, a presence server is defined as a server that manages presence information for a collection of entities, subscriptions to those entities, and their privacy restrictions.

Each server has an address at which presence messages may be delivered. Presence information is defined in the proposed presence server protocol specification as information such as presence status, current point-of-presence (if any), idle time, etc., for an entity. As used herein, the term presence information refers to any information regarding an end user or entity,

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Finally, a point of presence (PoP) is defined as a point of presence for an entity. If an entity is present, it is connected to one PoP. Each PoP has an address, e.g., an IP address and a port number, at which presence messages may be delivered.

A typical example of how the presence protocol may be used is as follows. An entity A connected to an endpoint E may subscribed through a presence server P to another entity B. When the status of B changes, P will notify E of the change in status of B, if B's privacy specifications allow. If P is unable to notify E, for instance, because E is unreachable, P marks E as absent and will subsequently not attempt to deliver to E until E reestablishes its presence. In addition, P may periodically ping an endpoint for current status information on the entities connected through that endpoint. Such a heartbeat from the presence server ensures that presence information stored at the server is current.

Once presence information about an entity is delivered to an endpoint, the endpoint may directly contact the entity. Protocols for exchanging instant

messages, file transfer, etc. between two such endpoints are not defined in the above-referenced presence protocol specification. Similarly, the protocol used for communication between clients and PoPs is outside the scope of the presence protocol specification. In addition, the transport protocol used to deliver presence messages including presence registration and update messages is not defined in the presence protocol specification.

One thing that the presence protocol specification does specify is message types used to perform presence-related actions. It is these message types that may be sent by a presence server to update and obtain presence information from a presence database. The message types include an assert message, which is sent by a PoP whenever the presence information associated with an entity changes. A fetch message is a request sent to the presence server to obtain presence information regarding a target specified in the fetch message. A subscribe message is a message sent to the presence server to allow the subscriber to receive presence information updates regarding a target specified in the subscribe message. A notify message is a message sent by the presence server to a requestor or a subscriber to convey presence information about a named entity.

There are currently models, including the models described above, that provide for instant messaging (IM) and presence services within the scope of an Internet Protocol / data network environment. It will be appreciated from the discussion above that one of the key elements of IM operation involves the ability for one subscriber to "know" when another subscriber is logged in or is "available." From the discussion above, it will also be appreciated that the ability to track the login status, otherwise known as "presence," of Internet

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users is fairly well developed and widely practiced. However, as communication networking technology has continued to evolve at a rapid pace, so have the means by which end users or subscribers can communicate. More particularly, the explosive growth of hand-held, wireless communication terminals, such as cell phones, wireless WEB phones, and personal digital assistants has led to a demand for inter-networking or inter-medium communication solutions. In other words, it is rapidly becoming useful for a subscriber to have their wireless phone status or "presence" known to other subscribers, where these other subscribers may be using a variety of communication mediums, such as wireless phone service, wired phone service, short message service (SMS), or Internet service.

At present, such data network-based presence models do not address the implementation of these services within a traditional Public Switched Telephone Network (PSTN) environment. Again, with the continuing movement towards the convergence of data and telephony networks, there exists the need to provide a system and method of enabling instant messaging and presence services in a communications environment that includes components of both traditional data and traditional telephony networks. Therefore, what is needed is an instant messaging / presence model for use in a converged data and telephony network.

Disclosure of the Invention

According to one aspect, the present invention includes a presence registration and routing node. The presence registration and routing node receives a signaling system 7 (SS7) message in response to a telephony-

related action, such as the activation of a mobile handset, the dialing of a directory number to establish a call, or the entry of predetermined DTMF digits. In response to the SS7 message, the presence registration and routing node formulates a presence-server-compatible message for updating
5 presence information regarding an end user in a presence server database. The presence-server-compatible message may be in any presence-server-compatible format, including session initiation protocol (SIP), presence, and Instant messaging and presence protocol (IMPP). SIP is defined in RFC 2543, SIP: Session Initiation Protocol (March 1999), the disclosure of which
10 is incorporated herein by reference in its entirety. IMPP is defined in RFC 2778, A Model for Instant Messaging, (February 2000) and in RFC 2779: Instant Messaging / Presence Protocol Requirements (February 2000), the disclosures of each of which are incorporated herein by reference in their entirety. Presence is defined in a variety of documents, including the IETF
15 Internet draft mentioned above and other IETF documents that will be discussed below. The present invention is not intended to be limited to any specific presence protocol format. The formats discussed herein are examples of presence protocol formats suitable for use with the present invention.

20 According to another aspect, a presence registration and routing node includes an advanced database communications module (ADCM) for receiving queries for presence information. The ADCM module forwards the queries to a presence application, such as a SIP, IMPP, or presence application. The presence application formulates a presence-server-compatible message, forwards the presence-server-compatible message to a
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presence database, receives a response from the database, and forwards the response to the ADCM module to be sent to the requestor over an IP network. The presence database may be internal or external to the presence registration and routing node.

5 Some aspects of the invention will be explained in terms of modules and processes. It is understood that these modules or processes may be implemented in hardware, software, or a combination of hardware and software. Exemplary hardware upon which the processes and modules described below may execute includes a microprocessor, such as an Intel
10 Pentium® processor and associated memory. Each of the modules in a presence registration and routing node according to the present invention may be a printed circuit board with a microprocessor and memory located thereon. The microprocessor may execute one or more computer programs for performing the presence registration and routing functions discussed below.

15 Accordingly, it is an object of the present invention to provide a presence registration and routing node for receiving SS7 messages in response to telephony-related actions and formulating presence-server-compatible messages in response to the SS7 messages.

20 It is another object of the present invention to provide a presence registration and routing node for receiving Internet Protocol (IP) encapsulated SS7 messages in response to telephony-related actions and formulating presence-server-compatible messages in response to the SS7 messages.

 It is another object of the present invention to provide a presence registration and routing node capable of routing presence-server-compatible

messages to a presence database and forwarding responses from the database over an IP network.

It is another object of the present invention to provide a presence registration and routing node that includes an internal or integrated presence database.

It is another object of the present invention to provide a presence registration and routing node that is adapted to maintain accounting or billing information related to presence database access.

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Brief Description of the Drawings

Preferred embodiments of the invention will now be explained with reference to the accompanying drawings of which:

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Figure 1 is a block diagram illustrating conventional presence and instant messaging message flow;

Figure 2 is a block diagram of an SS7/IP gateway that may be modified to perform presence message processing according to embodiments of the present invention;

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Figure 3 is a block diagram of a presence registration and routing node according to an embodiment of the present invention;

Figure 4 is a block diagram of a presence registration and routing node according to an embodiment of the present invention;

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Figures 5a and 5b are a flow chart illustrating exemplary steps that may be performed by a presence registration and routing node in processing an IAM message according to an embodiment of the present invention;

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Figure 6 is a block diagram illustrating SCCP encapsulation of an ISUP IAM message;

Figure 7 is a flow chart illustrating exemplary steps that may be performed by a presence registration and routing node in processing a TCAP message according to an embodiment of the present invention;

Figure 8 is a block diagram illustrating the operation of a presence registration and routing node in a mobile telecommunications network according to an embodiment of the present invention;

Figure 9 is a block diagram illustrating the operation of a presence registration and routing node in processing an IAM message according to an embodiment of the present invention;

Figure 10 is a block diagram illustrating the operation of a presence registration and routing node for in processing a TCAP message according to an embodiment of the present invention;

Figure 11 is a block diagram of a presence registration and routing node including an internal presence database according to an embodiment of the present invention;

Figure 12 is a flow chart illustrating exemplary steps that may be performed by the presence registration and routing node illustrated in Figure 11 in responding to a presence query for updating presence information according to an embodiment of the present invention;

Figure 13 is a block diagram of a presence registration and routing node including an external presence database according to an embodiment of the present invention.

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Figure 14 is a block diagram of a presence registration and routing according to an embodiment of the present invention that includes a message accounting and billing subsystem;

Figure 15 is a table that illustrates a sample usage and measurements database associated with a message accounting and billing subsystem of the present invention; and

Figure 16 is a block diagram of a presence registration and routing according to an embodiment of the present invention that includes a presence database and message accounting and billing subsystem.

Detailed Description of the Invention

The present invention includes a presence registration and routing (PRR) node for communicating with and routing messages between both Internet Protocol (IP) and Signaling System 7 (SS7) network nodes. In one embodiment, a PRR node employs an internal architecture similar to that of high performance STP and signaling gateway (SG) products which are marketed by Tekelec, Inc., of Calabasas, California as the Eagle[®] STP and IP⁷ Secure Gateway[™], respectively. A block diagram that generally illustrates the base internal architecture of the Eagle[®] STP product is shown in Figure 2.

A detailed description of the Eagle[®] STP may be found in the *Eagle[®] Feature Guide* PN/910-1225-01, Rev. B, January 1998, published by Tekelec, the disclosure of which is incorporated herein by reference in its entirety. Similarly, a detailed description of the IP⁷ Secure Gateway[™] may be found in Tekelec publication PN/909-0767-01, Rev B, August 1999, entitled *Feature Notice IP⁷ Secure Gateway[™] Release 1.0*, the disclosure of which is

incorporated herein by reference in its entirety. The specific functional components of an IP⁷ Secure Gateway[™] for transmitting and receiving TCAP messages over an Internet Protocol (IP) network are described in commonly-assigned, co-pending International Patent Publication No. WO 00/35155, Published June 15, 2000, the disclosure of which is incorporated herein by reference in its entirety. As described in the above referenced *Eagle[®] Feature Guide*, an Eagle[®] STP **250** includes the following subsystems: a Maintenance and Administration Subsystem (MAS) **252**, a communication subsystem **254** and an application subsystem **256**. The MAS **252** provides maintenance communications, initial program load, peripheral services, alarm processing and system disks. The communication subsystem **254** includes an Interprocessor Message Transport (IMT) bus that is the main communication bus among all subsystems in the Eagle[®] STP **250**. This high-speed communications system functions as two 125 Mbps counter-rotating serial buses.

The application subsystem **256** includes application cards that are capable of communicating with the other cards through the IMT buses. Numerous types of application cards can be incorporated into STP **250**, including: a Link Interface Module (LIM) **258** that provides SS7 links and X.25 links and an Application Service Module (ASM) **262** that provides global title translation, gateway screening and other services. A Translation Service Module (TSM) **264** may also be provided to support triggered local number portability service. Once again, a detailed description of the Eagle[®] STP is provided in the above cited *Eagle[®] Feature Guide* and need not be described in detail herein. With particular regard to the signaling gateway (SG) product

line produced by Tekelec, it should also be appreciated that a Database Communication Module (DCM) 260 can be employed to provide for the transport of Internet Protocol (IP) encapsulated SS7 messages over an IP network, as described in the above referenced *Feature Notice IP⁷ Secure Gatewaytm Release 1.0* publication. With further regard to the TSM triggered LNP services module mentioned above, a detailed description of the Tekelec triggered LNP solution may be found in the *Feature Guide LNP LSMS* PN/910-1598-01, Rev. A, January 1998, published by Tekelec, the disclosure of which is hereby incorporated herein by reference. Furthermore, systems and methods for providing triggerless LNP functionality within a network routing node are described in commonly-assigned, co-pending U.S. Patent Application No. 09/503,541, filed February 14, 2000, the disclosure of which is incorporated herein by reference in its entirety.

SS7 MSU Triggered Presence Registration Message Generation

Shown in Figure 3 is a schematic diagram of a presence registration and routing node 300 of the present invention. It will be appreciated that presence registration and routing node 300 includes a high speed Interprocessor Message Transport (IMT) communications bus 310. Communicatively coupled to IMT bus 310 are a number of distributed processing modules or cards including; a pair of Maintenance and Administration Subsystem Processors (MASPs) 312, an SS7 capable Link Interface Module (LIM) 320, an IP capable Advanced Database Communication Module (ADCM) 360, and a Presence Registration Module (PRM) 340. These modules are physically connected to the IMT bus 310

such that signaling and other type messages may be routed internally between all active cards or modules. For simplicity of illustration, only a single LIM 320, ADCM 360, and PRM 340 are included in Figure 3. However, it should be appreciated that the distributed, multi-processor architecture of the presence registration and routing node 300 facilitates the deployment of multiple LIM, ADCM, PRM, and other cards, all of which could be simultaneously connected to the IMT bus 310.

MASP pair **312** implements the maintenance and administration subsystem functions described above. As the MASP pair **312** are not particularly relevant to a discussion of the flexible routing attributes of the present invention, a detailed discussion of their function is not provided herein. For a comprehensive discussion of additional MASP operations and functionality, the above-referenced Tekelec publications can be consulted.

Focusing now on LIM card functionality, it will be appreciated that LIM 320 is comprised of a number of sub-component processes including, but not limited to; an SS7 MTP level 1 process 322, an SS7 MTP level 2 process 324, an I/O buffer or queue 325, a gateway screening (GWS) process 326, a Presence Registration Request (PRR) stop action process 328, an SS7 MTP level 3 layer HMDC process 330, and an HMDT process 332. MTP level 1 and 2 processes 322 and 324, respectively, provide the facilities necessary to send and receive digital data over a particular physical media / physical interface, as well as to provide error detection / correction and sequenced delivery of all SS7 message packets. I/O queue 325 provides for temporary buffering of incoming and outgoing signaling message packets. GWS process 326 is responsible for examining the incoming signaling message and

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determining which, if any, of the provisioned stop actions are applicable. PRR stop action process **328** is responsible for making a copy of, and subsequently encapsulating, an incoming SS7 ISDN User Part (ISUP) IAM signaling message packet within an SS7 Signaling Connection Control Part (SCCP) formatted packet. It should be appreciated that PRR stop action process **328** could also be configured to simply encapsulate the original incoming SS7 ISUP IAM signaling message, without making a copy. MTP level 3 HMDC process **330** receives signaling messages from the lower processing layers and performs a discrimination function, effectively determining whether an incoming SS7 message packet requires internal processing or is simply to be through switched. For instance, in the case of an SS7 TCAP message associated with presence registration or an SCCP encapsulated ISUP IAM message, HMDC process **330** would determine that the message should be internally routed for further processing. The HMDT process **332** manages or directs the internal routing of SS7 message packets that require additional processing prior to final routing. Once again, it should be appreciated that a LIM card may contain more functional processes than those described above. The above discussion is limited to LIM functionality associated with the basic processing of in-bound signaling messages.

As such, it will be appreciated that the three functional processes associated with an Advanced Database Communication Module (ADCM) **360** shown in Figure 3 are simply those processes that are relevant to a discussion of out-bound ADCM operation in the examples of PS routing node operation disclosed herein. Furthermore, it will be appreciated that ADCM **360** is similar in function to the DCM application module described above. In

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In general, a PRM card includes the database and processes necessary to achieve the presence registration and routing functionality of the present invention. The PRM card 340, shown in Figure 3 is comprised, in part, of an SCCP suite 342, which may be implemented as a Signaling Connection Routing Controller (SCRC) and a Presence Registration Manager (PRMG) process 344, which may be implemented as a Presence Registration Applications generally indicated by 346. One of the applications included among the Presence Registration Applications is a SIP registration application process 348 for processing SIP messages, forwarding the SIP messages to a presence server 350, and processing SIP messages received from the presence server 350.

15 In general, a PRM card includes the database and database control
processes necessary to achieve the presence registration message
generation and routing functionality of the present invention. The PRM **340**
shown in Figure 3 is comprised, in part, of an SCCP subsystem controller
known as a Signaling Connection Routing Controller (SCRC) process **342**, a
20 Presence Registration Manager (PRMG) process **344**, and a number of
Presence Registration Applications generally indicated by the numeral **346**.
Included among the Presence Registration Applications is a session initiation
protocol (SIP) registration application process **348** for generating SIP
messages, forwarding the SIP messages to a presence server, and
25 processing SIP messages received from the presence server. The format for

SIP messages is described in detail in the above-referenced RFC 2543, which defines the SIP protocol. In addition, the portion of a SIP message that carries the media capabilities information for an end user device is referred to as the session description protocol portion. The session description protocol is described in detail in RFC 2327, "SDP: Session Description Protocol," (April 1998), the disclosure of which is incorporated herein by reference in its entirety.

Presence protocol process 349 may also be included for communicating with a presence server using the messages described in the above-referenced presence protocol specification.

Instant messaging and presence protocol (IMPP) process 351 may also be included for communicating with a presence server according to the IMPP protocol. The IMPP protocol is described in detail above and in one or more of the following IETF Internet draft documents:

"Message Information Data Format," <draft-ietf-impp-midf-01.txt>, January 19, 2000;

"Presence Information Data Format for IMPP," <draft-ietf-impp-pidf-01.txt>, March 10, 2000; and

"Transport Protocol for Presence Information/ Instant Messaging," <draft-ietf-impp-pitp-mitp-01>, March 9, 2000,

the disclosures of each of which are incorporated herein by reference in their entirety.

The present invention is not limited to communicating with a presence server using SIP, IMPP, or presence protocols. Any protocol for communicating with a presence server is within the scope of the invention.

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While any of the above-described presence registration applications may be provisioned on a single PRM card, SIP registration application 348 is used in the examples described herein to illustrate the functionality of the presence registration and routing node in updating presence information in a presence server database and obtaining presence information. SIP

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which, if any, of the provisioned stop actions are applicable to the incoming message. In this example, GWS process **326** examines the incoming ISUP IAM message and determines that the message is permitted to enter the switch. Furthermore, upon examination of the Originating Point Code (OPC),
5 Destination Point Code (DPC) and Service Indicator Octet (SIO) fields contained in the MTP routing layer, it is determined that the message requires additional processing by the PRR stop action **328 (ST5)**. In steps **ST6** PRR stop action process **328** receives the ISUP IAM message from GWS process **326** and determines that the incoming message is an ISUP type MSU. The
10 PRR stop action process **328** next checks the DPC of the incoming MSU. More specifically, the PRR stop action verifies that the DPC of the incoming MSU is a valid PC. PRR stop action **328** examines the incoming MSU to determine whether presence registration service is required. If the incoming MSU is identified as being an ISUP IAM type message, PRR stop action **328**
15 encapsulates a copy of the ISUP IAM message within an SCCP formatted MSU, as indicated in step **ST6**. Such SCCP encapsulation is effectively achieved by adding essential SCCP message leading and trailing bit sequences to the base bit sequence that comprises the ISUP IAM MSU, as generally illustrated in Figure 6. Thus, an SCCP type encapsulated MSU is
20 created which envelops or contains an ISUP type MSU. Subsequent to this encapsulation, the incoming message no longer appears or is treated as an ISUP IAM message within the presence registration and routing node **300**, but is instead processed internally as an SCCP type SS7 message.

Unless additional processing by an unrelated subsystem is required,
25 the original ISUP IAM MSU is then routed directly to HMDC process **330**

where normal ISUP MSU type routing is resumed. However, once again, it should be appreciated that the original ISUP IAM MSU could be SCCP encapsulated and further processed instead of producing a copy of the ISUP MSU. It should also be appreciated that failure of the incoming ISUP MSU to meet the criteria specified in step causes the original, non-encapsulated MSU to be routed directly to HMDC process **330** where normal ISUP MSU type routing is resumed.

However, in the case where an incoming ISUP MSU satisfies the **ST5** criteria, SCCP encapsulation of the ISUP MSU occurs and the resulting encapsulated MSU is directed to HMDC process **330 (ST7)**, where SCCP type processing is performed. In the example shown in Figure 3, HMDC process **330** examines the message packet and determines that the DPC and Subsystem Number (SSN) of the SCCP packet is the PC of the presence registration and routing node. Consequently, further processing of the SCCP MSU within the routing node is assumed to be necessary, and the packet is passed to the HMDT process **332**. The HMDT process **332** examines the Service Indicator (SI) field of the encapsulated MSU, which indicates that the encapsulating packet is of an SCCP type. As such, HMDT process **332** places the encapsulated SCCP MSU on high speed IMT bus **310** for transport to PRM **340** and subsequent presence registration service.

Referring to Figure 5b, in step **ST8**, the encapsulated SCCP MSU is received and examined by SCRC process **342** that is resident on PRM **340**. SCRC process **342** examines the message, determines that presence registration service is indicated, and forwards the encapsulated MSU to the PRMG process **344**, as indicated by step **ST9**. In step **ST10**, PRMG process

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indicated in Figures 5a and 5b. The primary difference involves processing variations that result from the handling of SS7 ISUP versus SS7 TCAP type messages. Most notably, since a TCAP message is, in fact, also an SCCP message, there is no need to directly encapsulate or copy and encapsulate the incoming TCAP message. Instead the TCAP message is simply directed from the inbound LIM **320** to the associated PRM **340** via the high speed IMT Bus **310**, in much the same manner as the SCCP encapsulated ISUP IAM described in detail above. As such, Figure 7 presents a flow chart of the major steps associated with the processing of a TCAP-type presence registration request message, which may be used in conjunction with the schematic diagram shown in Figure 4 to better understand the TCAP based presence registration message generation methodology.

With particular regard to the scenario generally illustrated in Figure 4, an incoming TCAP-formatted presence registration request message is received at the inbound LIM module **320** (**ST1**). Once again, in steps **ST2** and **ST3**, the incoming TCAP message is received and processed by the MTP Level 1 and 2 processes **322** and **324**, respectively. With MTP Level 1 and 2 processing complete, the signaling message packet is temporarily buffered in the I/O queue **325** before being passed up the stack to the MTP Level 3 Gateway Screening (GWS) process **326**. As indicated in step **ST4**, GWS process **326** examines the incoming TCAP message and determines not only whether the message is to be allowed into the switch for further processing, but also which, if any, of the provisioned stop actions are applicable to the incoming message. In the scenario shown in Figure 4, GWS process **326** examines the incoming TCAP message and determines that the message is

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within the MSU, generates a SIP-formatted presence registration message (ST8).

With SIP processing complete, the SIP-formatted presence registration message is passed to HMRT process 350. HMRT process 350 determines to which ADCM card the SIP registration message packet should be routed for subsequent outbound transmission (ST9). In this case, the HMRT process 350 determines that the desired outbound signaling link associated with the routing of the SIP registration message is located on ADCM 360. Consequently, the SIP message packet is internally routed across the IMT bus 310 to LIM 360, where it is generally received by the I/O queue process 362 (ST10). Eventually, the modified message packet is passed from the I/O queue 362 on to the IP Level 2 and Level 1 processes 364 and 366, respectively (ST11). As indicated in step ST12, the SIP-formatted presence registration message is then transmitted into an IP network for ultimate delivery to and use by a presence database system.

Shown in Figures 8, 9 and 10 are simplified network diagrams that illustrate example implementations of the embodiments described above. More particularly, Figure 8 illustrates an implementation of the presence registration and routing node 300 of the present invention in a mobile or wireless telecommunications environment, generally indicated by the numeral 400. Network 400 includes a mobile subscriber 402, a base station complex 404, a mobile switching center (MSC) 406, a home location register (HLR) 408, and a presence server 410. It will be appreciated that the message flows shown in Figure 8 indicate that the presence registration and routing node 300 formulates and transmits a presence registration message 416 in response to

the receipt of a location update message **412** that is sent from the MSC **406**. Those skilled in the art of wireless telecommunications will appreciate that an MSC performs a number of functions in a wireless network, including the formulation and routing of signaling messages. In the example shown in Figure 8, the location update signaling message used by the presence registration and routing node **300** to trigger the presence registration message **416** is destined for the HLR node **408**. In such a wireless scenario, the presence registration message **416** could be formulated and transmitted by the presence registration and routing node in response to a mobile location update message associated with the registration of a wireless customer in a particular cell or service area. Once again, those skilled in the art of wireless or mobile telecommunications will appreciate that wireless or mobile signaling messages are generated and transmitted within a wireless network in response to the powering-up or turning-on of a customer's wireless phone, as well as in response to inter-cell movement of a mobile subscriber during the course of a mobile call. As such, the presence registration and routing node of the present invention facilitates a method of presence registration that is completely transparent to the cell or mobile phone user.

Figure 9 illustrates an implementation of the presence registration and routing node **300** of the present invention in a wired telecommunications environment, generally indicated by the numeral **420**. Network **420** includes a wireline subscriber **422**, an end office (EO) **424**, and a presence server **426**. It will be appreciated that the message flows shown in Figure 9 indicate that the presence registration and routing node **300** formulates and transmits a presence registration message **434** in response to the receipt of an ISUP call

signaling message from the EO 424. More particularly, the presence registration message 434 is generated in response to the receipt of an ISUP Initial Address Message (IAM) message 428. Those skilled in the art SS7 signaling will appreciate that an ISUP IAM message is the first in a sequence of ISUP formatted SS7 call control signaling messages that are required to complete a phone call in the Public Switched Telephone Network (PSTN). As such, it will be appreciated that in the scenario illustrated in Figure 9, the presence registration message 434 is formulated in response to an attempt by the wireline subscriber 422 to place a telephone call. As presence registration message generation is triggered by an ISUP IAM message, it will be appreciated by those skilled in the art of SS7 telecommunications that completion of an attempted telephone call is not required in order for a presence registration message to be generated and transmitted to a presence server. Thus, any call attempts by the wireline subscriber 422 will effectively register the subscriber's presence with the presence server 426 via the presence registration and routing node 300 of the present invention. It will also be appreciated from Figure 9, that the triggering ISUP IAM message 428 is subsequently routed as normal, on to a destination address specified in the message.

Shown in Figure 10 is a variation of the scenario that was illustrated in Figure 9 whereby an SS7 signaling message used to trigger the formulation and subsequent transmission of a presence registration message is comprised of a TCAP-type message instead of an ISUP-type message. Shown in Figure 10 is an implementation of the presence registration and routing node 300 of the present invention in a wired telecommunications

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The embodiments of the present invention described in detail above can be easily extended to include a presence registration and routing node that is capable of maintaining a presence database system. One embodiment of such a presence registration and routing node is illustrated in Figure 11, and generally indicated by the numeral 500. It will be appreciated that in the particular embodiment presently contemplated, presence registration messages are not formulated and routed from the node, but instead presence registration takes place at or within the node. That is, in the embodiment of the present invention shown in Figure 11 and generally discussed below, the

With particular regard to the embodiment illustrated in Figure 11 and in a manner similar to the embodiment described above, it will be appreciated that presence registration and routing node **500** includes a high speed Interprocessor Message Transport (IMT) communications bus **310**. Communicatively coupled to IMT bus **310** are a number of distributed processing modules or cards including; a pair of Maintenance and Administration Subsystem Processors (MASPs) **312**, an SS7 capable Link Interface Module (LIM) **320**, an IP capable Advanced Database Communication Module (ADCM) **360**, and a Presence Database Module (PDM) **502**. These modules are physically connected to the IMT bus **310** such that signaling and other type messages may be routed internally between all active cards or modules. For simplicity of illustration, only a single LIM **320**, ADCM **360**, and PDM **502** are included in Figure 11. However, it should be appreciated that the distributed, multi-processor architecture of the presence registration and routing node **500** facilitates the deployment of multiple LIM, ADCM, PDM, and other cards, all of which could be simultaneously connected to the IMT bus **310**.

As in the previously described embodiment, MASP pair **312** implement the overall maintenance and administration subsystem functions. For a comprehensive discussion of additional MASP operations and functionality, the above-referenced Tekelec publications can be consulted.

Once again, it will be appreciated that LIM 320 is comprised of a number of sub-component processes including, but not limited to; an SS7

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MTP level 1 process **322**, an SS7 MTP level 2 process **324**, an I/O buffer or queue **325**, a gateway screening (GWS) process **326**, a Presence Server Request (PRR) stop action process **328**, an SS7 MTP level 3 layer HMDC process **330**, and an HMDT process **332**. MTP level 1 and 2 processes **322** and **324**, respectively, provide the facilities necessary to send and receive digital data over a particular physical media / physical interface, as well as to provide error detection / correction and sequenced delivery of all SS7 message packets. I/O queue **325** provides for temporary buffering of incoming and outgoing signaling message packets. GWS process **326** is responsible for examining the incoming signaling message and determining which, if any, of the provisioned stop actions are applicable. PRR stop action process **328** is responsible for making a copy of, and subsequently encapsulating, an incoming SS7 ISDN User Part (ISUP) IAM signaling message packet within an SS7 Signaling Connection Control Part (SCCP) formatted packet. It should be appreciated that PRR stop action process **328** could also be configured to simply encapsulate the original incoming SS7 ISUP IAM signaling message, without making a copy. MTP level 3 HMDC process **330** receives signaling messages from the lower processing layers and performs a discrimination function, effectively determining whether an incoming SS7 message packet requires internal processing or is simply to be through switched. For instance, in the case of an SS7 TCAP message associated with presence registration or an SCCP encapsulated ISUP IAM message, HMDC process **330** would determine that the message should be internally routed for further processing. The HMDT process **332** manages or directs the internal routing of SS7 message packets that require additional

In general, a PDM card includes the database and database control processes necessary to facilitate the presence registration and query handling functionality of the contemplated embodiment of the present invention. The PDM 502 shown in Figure 11 is comprised, in part, of an SCCP subsystem controller known as a Signaling Connection Routing Controller (SCRC) process 504, a Presence Database Manager (PDMG) process 510, and a number of Presence Database Interface (PDI) Applications generally indicated by the numeral 512. Included among the PDI Applications 512 are session initiation protocol (SIP) application process 518, IMPP application process 514, and presence protocol process 519. The SCRC process 504 is responsible for discrimination of signaling messages and subsequent distribution of these signaling messages to an appropriate higher processing level application or function. In the configuration shown in Figure 11, the next highest processing level is represented by the PDMG process 510. PDMG process 510 is generally responsible for determining which of the provisioned protocol-specific PDI Applications 512 is required process the incoming message packet. For instance, if the incoming presence registration packet contained a TCAP or SCCP-encapsulated IMPP message, PDMG process 510 would determine that the provisioned PDI application 514 was required for successful processing. As will be appreciated from Figure 11, a number of PDI applications 512 may be simultaneously provisioned on a single PDMG card. These protocol-specific PDI applications may be configured such that each application is capable of receiving presence registration or query messages that are formatted in different protocols including, but not limited to, SIP, IMPP, and the presence protocol. Furthermore, these PDI applications

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512 are also capable of generating or formatting protocol-specific presence service related response messages. Such a presence service response message might include, but is not limited to, a message that provides presence status information for a specific user in response to a presence status query. This particular scenario is specifically illustrated in Figure 11, where the presence status query packet assumes the form of an SS7 TCAP-encapsulated IMPP query message and the subsequent presence status response is contained within a SIP formatted message.

Once again, while any number or variety of PDI applications may be provisioned on a single PDM card, only the IMPP, SIP, and presence protocol PDI applications 514, 518, and 519, respectively, are described herein. SIP PDI application 518 essentially contains the logic necessary to process incoming SIP presence messages and construct outgoing SIP presence response messages. Similarly, IMPP PDI application 514 contains the logic necessary to process incoming IMPP formatted presence messages and construct outgoing IMPP formatted presence response messages. Presence PDI application 519 contains the logic necessary to process incoming presence query messages formatted according to the presence protocol and construct outgoing presence response messages formatted according to the presence protocol.

Also included in Figure 11 is a general message flow associated with the processing of an incoming SS7 TCAP-encapsulated IMPP formatted presence query message and the subsequent, related presence system processing activity. A detailed flow chart of the major steps associated with a TCAP-encapsulated IMPP presence query scenario is presented in Figure 12,

and may be used in conjunction with the schematic diagram shown in Figure 11 to better understand the operation of presence registration and routing node 500.

With particular regard to the scenario generally illustrated in Figure 11, it is assumed that an incoming TCAP-encapsulated IMPP formatted presence query message is received at the inbound LIM module 320 (ST1). Once again, in steps ST2 and ST3, the incoming TCAP-encapsulated IMPP formatted presence query message is received and processed by the MTP Level 1 and 2 processes 322 and 324, respectively. With MTP Level 1 and 2 processing complete, the signaling message packet is temporarily buffered in the I/O queue 325 before being passed up the stack to the MTP Level 3 Gateway Screening (GWS) process 326. As indicated in step ST4, GWS process 326 examines the incoming TCAP presence query message and determines not only whether the message is to be allowed into the switch for further processing, but also which, if any, of the provisioned stop actions are applicable to the incoming message. In the scenario shown in Figure 11, GWS process 326 examines the incoming TCAP-encapsulated IMPP presence query message and determines that the message is permitted to enter the switch. Furthermore, upon examination of the Originating Point Code (OPC), Destination Point Code (DPC) and Service Indicator Octet (SIO) fields contained in the MTP routing layer, it is determined that the message does not require additional processing by the PRR stop action 328. As such, the TCAP MSU is then routed directly to HMDC process 330 where SCCP type processing is performed (ST5). In the example shown in Figure 11, HMDC process 330 examines the message packet and determines that the

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DPC and Subsystem Number (SSN) of the TCAP packet is the PC and SSN of the internal presence server database system that is located on PDM card 502. Consequently, further processing of the TCAP MSU within the routing node is assumed to be necessary, and the packet is passed to the HMDT process 332. The HMDT process 332 examines the Service Indicator (SI) field of the TCAP MSU, which indicates that the packet is of an SCCP type. As such, HMDT process 332 places the TCAP MSU on high speed IMT bus 310 for transport to PDM 502 and subsequent presence database service.

In step ST6, the TCAP MSU is received and examined by SCRC process 504 that is resident on PDM 502. SCRC process 504 examines the message, determines that presence database service is indicated, and forwards the TCAP MSU to the PDMG process 510. As indicated in step ST7, the message packet is examined to determine the protocol of the presence related message. In this case, the protocol of the presence related message encapsulated within the TCAP packet is IMPP. Next in step ST8 the variety or type of presence service associated with the message is evaluated. Such general presence message types or varieties might include, but are not limited to, query and registration type messages.

Once again, in this example, the IMPP-formatted presence service message is a query message that is intended to extract information from a presence service database. As such, the IMPP formatted query message is directed to IMPP application 514 for further processing. IMPP application 514 examines the message and, using information contained within the packet, directs the query to presence database 516 (ST9). Presence database 516 processes the query and, in this example, returns the requested information to

SIP application **518** for formatting of the out-bound response message (ST10).

With the necessary SIP formatting complete, the SIP-formatted presence registration message is passed to an HMRT process **520**. HMRT process **520** determines to which ADCM card the SIP registration message packet should be routed for subsequent outbound transmission (ST11). In this case, the HMRT process **520** determines that the desired outbound signaling link associated with the routing of the SIP registration message is located on ADCM **360**. Consequently, the SIP message packet is internally routed across the IMT bus **310** to LIM **360**, where it is generally received by the I/O queue process **362** (ST12). Eventually, the modified message packet is passed from the I/O queue **362** on to the IP Level 2 and Level 1 processes **364** and **366**, respectively. As indicated in step ST13, the SIP-formatted presence registration message is then transmitted into an IP network for ultimate delivery to and use by a presence database system.

It will be appreciated from Figure 12, that if the IMPP-formatted presence service message were a registration request-type message, then IMPP application **514** would examine the message and, using information contained within the packet, direct the registration request to presence database **516** (ST14). In such a scenario, a response or acknowledgment message may not necessarily be required.

Externally Mounted Presence Database System

The embodiments of the present invention described in detail above can be easily extended to include a presence registration and routing node

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In general, an EPDM card **700** includes the database and database control processes necessary to facilitate the presence registration and query handling functionality of the contemplated embodiment of the present invention. The EPDM **700** shown in Figure 13 is comprised, in part, of an
5 SCCP subsystem controller known as a Signaling Connection Routing Controller (SCRC) process **504**, a Presence Database Manager (PDMG) process **510**, and a number of Presence Database Interface (PDI) Applications generally indicated by the numeral **512**. Included among the PDI Applications **512** are a session initiation protocol (SIP) application process
10 **518**, an IMPP application process **514**, and a presence protocol process **519**. The SCRC process **504** is responsible for discrimination of signaling messages and subsequent distribution of these signaling messages to an appropriate higher processing level application or function. In the configuration shown in Figure 13, the next highest processing level is
15 represented by the PDMG process **510**. PDMG process **510** is generally responsible for determining which of the provisioned protocol-specific PDI Applications **512** is required process the incoming message packet. The PDI applications **512** are capable of generating or formatting protocol-specific presence service related response messages. Such a presence service
20 response message might include, but is not limited to, a message that provides presence status information for a specific user in response to a presence status query.

In the embodiment shown in Figure 13, EPDM card **700** further includes an Ethernet Controller (EC) process **702** which is communicatively
25 coupled to the provisioned PDI applications **512** and also to the external

5 **516.** In all other respects, operation of the presence registration and routing node is identical to that of presence registration and routing node **500** described above and illustrated in Figure 11.

Integrated Message Accounting And Billing Subsystem

Shown in Figure 14 is another embodiment of a presence registration and routing node of the present invention, generally indicated by the numeral **900**. With particular regard to the embodiment illustrated in Figure 14 and in a manner similar to the embodiment described above, it will be appreciated that presence registration and routing node **900** includes a high speed Interprocessor Message Transport (IMT) communications bus **310**. As in the previously described embodiments, communicatively coupled to IMT bus **310** are a number of distributed processing modules or cards including; a pair of Maintenance and Administration Subsystem Processors (MASPs), an SS7 capable Link Interface Module (LIM) **320**, and an IP capable Advanced Database Communication Module (ADCM) **360**, and a Presence Registration Module (PRM) **340**. Further included in the presence registration and routing node **900** is an accounting and billing subsystem which is comprised of an accounting subsystem interface module (ASIM), generally indicated by the numeral **910**, and an accounting server platform (ASP), generally indicated by the numeral **920**. It will be appreciated that the combination of ASIM card **910**

and ASP accounting server **920** includes the database and control processes necessary to achieve the accounting and billing functionality of the present invention. From a practical implementation standpoint, ASP **920** could assume the form of a Sun Workstation or similar type computing platform. It will be further appreciated that an entire message accounting subsystem could also be integrated within a presence routing and registration node.

The ASIM card **910** shown in Figure 14 includes a Signaling Connection Control Part (SCCP) subsystem **912** that is responsible for receiving and preliminary processing of incoming SCCP encapsulated accounting message packets. ASIM card **910** also includes an SCCP controller known as a Signaling Connection Routing Controller (SCRC) process **914** and a high-speed Ethernet Controller (EC) process **916**. Once again, as described above, the SCCP subsystem **912** is responsible for receiving and preliminary processing of incoming SCCP encapsulated message packets, while the SCRC process **914** is responsible for discrimination and subsequent distribution of messages based on information contained in an SCCP packet. In the case of ASIM card **910**, messages that satisfy the SCRC discrimination criteria are distributed or directed to the high-speed Ethernet Controller process **916**. EC process **916** is in turn responsible for controlling the process of communicating messages, via an Ethernet connection to and from the associated ASP server **920**. More particularly, ASP server **920** includes a corresponding high-speed Ethernet Controller process **922** that serves as the communications interface between ASIM card **910** and an on-board accounting server manager (ASM) process **924**. ASM process **924** is responsible for the de-capsulation or removal of the SCCP

envelope that contains the accounting message. The de-capsulated accounting message is then passed to an adjacent usage and measurements process 926 where usage and measurement statistics are created and stored in a usage and measurements database (UMD) process 930, such as that shown in Figure 15.

Usage and measurements statistics produced by such a process could include, but are not limited to, peg counts of messages received from a specific network address, a specific service provider, a specific service user, a specific IP socket, or a specific signaling link. Furthermore, information specific to the type of service requested, calling and called party information, and other information associated with a communication that could be useful in generating a bill or invoice may also be stored in a UMD. As shown in sample UMD process 930, in one simplified embodiment, each communication is identified by a transaction ID, and certain predetermined information associated with a communication can be stored in the database. It will be appreciated that the information contained in a UMD database could be significantly more or less detailed than that indicated in the example shown in Figure 15.

In any event, such statistics could include information associated with the time-of-day that a message was received, the duration of a "call" or communication, general quality of service (QoS) indicators associated with a "call" or communication, information related to or identifying the type of service that is associated with a "call" or communication (i.e., broadband service related, call setup related, database query related, etc.). Such usage information could be used to bill a subscriber at different rates depending

upon the type of service requested. With such capability included within a presence server and routing node, network operators greatly increased flexibility with regard to service-specific billing, without significantly increasing network OA&M requirements.

5 In order to facilitate such billing operations, ASP server **920** also includes a billing process **928** that is adapted to extract information stored by the usage and measurements process **926** and subsequently generate bills. Once again, information or parameters maintained by process **926** that may be used in the generation of bills could include, but is not limited to, a network
10 address identifier, a service provider identifier, a service user identifier, an IP socket identifier, a signaling link identifier, and a service type identifier. It will be further appreciated that a network address identifier could include, but is not limited to a destination or origination SS7 point code, a destination or origination IP address, and a destination or origination domain name.
15 Similarly, a user identifier could include, but is not limited to a calling or called party telephone number, and a destination or origination email address.

In the particular embodiment shown, LIM card **320** includes a Presence Registration Request (PRR) stop action process **902**, that is functionally similar to the PRR process **328** described above. In addition to generate, and
20 SCCP encapsulate an accounting message that is subsequently passed via IMT bus **310** to ASIM **910** of the accounting and billing subsystem.

In a preferred embodiment, a normalized accounting message (NAM) format is employed to provide the necessary message information content to the associated accounting and billing subsystem. That is, a NAM formatted
25 accounting message employs a field or record structure that is essentially a

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embodiments described above, it will be appreciated that presence registration and routing node **950** includes a high speed Interprocessor Message Transport (IMT) communications bus **310**. Communicatively coupled to IMT bus **310** are a number of distributed processing modules or cards including; a pair of Maintenance and Administration Subsystem Processors (MASPs), an SS7 capable Link Interface Module (LIM) **320**, and an IP capable Advanced Database Communication Module (ADCM) **360**, and a Presence Registration Module (PRM) **340**. Further included in the presence registration and routing node **950** is an accounting and billing subsystem which is comprised of an accounting subsystem interface module (ASIM), generally indicated by the numeral **910**, and an accounting server platform (ASP), generally indicated by the numeral **920**. Again, it will be appreciated that the combination of ASIM card **910** and ASP accounting server **920** includes the database and control processes necessary to achieve the accounting and billing functionality of the present invention.

In the particular embodiment shown, LIM card **320** includes a Presence Registration Request (PRR) stop action process **952**, that is functionally similar to the PRR process **902** described above. PRR **952** is adapted to generate, and SCCP encapsulate, an accounting message that is subsequently passed via IMT bus **310** to ASIM **910** of the accounting and billing subsystem, where accounting and billing subsystem processing occurs in a manner similar to that described above.

It will be understood that various details of the invention may be changed without departing from the scope of the invention. Furthermore, the

foregoing description is for the purpose of illustration only, and not for the purpose of limitation—the invention being defined by the claims.

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